(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
25 April 2002 (25.04.2002)

PCT

(10) International Publication Number
WO 02/33681 A2

(51) International Patent Classification[7]: G09F

(21) International Application Number: PCT/US01/32252

(22) International Filing Date: 17 October 2001 (17.10.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
09/690,507 17 October 2000 (17.10.2000) US

(63) Related by continuation (CON) or continuation-in-part (CIP) to earlier application:
US 09/690,507 (CON)
Filed on 17 October 2000 (17.10.2000)

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(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *without international search report and to be republished upon receipt of that report*

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WO 02/33681 A2

(54) Title: METHOD AND APPARATUS FOR REMOTELY VIEWING RADIOLOGICAL IMAGES

(57) Abstract: The radiologist analyzes radiographic images using a portable, body-mounted viewing unit, which may include retinal impingement head-mounted display. The viewing unit is coupled to a computer network for downloading image data from the clinic or hospital where the images were taken. The viewing unit thus eliminates the need for the radiologist to schedule time in a radiological reading room and empowers the radiologist to work anywhere.

BNSDOCID: <WO_____0233681A2_I_>

METHOD AND APPARATUS FOR REMOTELY VIEWING RADIOLOGICAL IMAGES

BACKGROUND

The current method of reading radiological materials such as digital x-ray images, computed tomography (CT) images, or magnetic resonance (MR) images involves viewing the images on high-resolution monitors in controlled environments. It is necessary to view the images in high resolution both to ensure the quality of diagnosis and to comply with the ACR standards. The controlled environments generally include the reduction of visual distractions and ambient light. For example, hospitals may provide radiological reading stations in specially designated low light rooms.

This method has several disadvantages. For instance, the high-resolution monitors provide a large expense relative to a common computer monitor, driving up the cost of viewing stations. Additionally, because the viewing stations are in designated environmentally controlled rooms with set numbers of viewing stations, there is a limit imposed upon the number of radiologists who can use the viewing stations at a given time, negatively impacting throughput. Furthermore, radiologists are geographically limited in where they can perform their work, namely at a hospital that has a radiological reading room. This also negatively impacts throughput. Additionally, the investment necessary to set up a radiology reading room can prohibit smaller clinics from providing on-site reading, which is a particular concern for digital mammography applications.

Therefore, it is an object of the present invention to provide a way to remotely view radiographic images.

SUMMARY OF THE INVENTION

The above and other objects are provided by a method and apparatus for remotely viewing radiographic images. Radiographic images are acquired.

The acquired images are retrieved by a remote computing device. The images are then viewed on a remote viewing device.

BRIEF DESCRIPTION OF DRAWINGS

The various advantages of the present invention will become apparent to one skilled in the art by reading the following specification and subjoined claims and by referencing the following drawings in which:

Figure 1 is a remote radiographic reading system in accordance with a preferred embodiment of the present invention;

Figure 2 is an alternative preferred embodiment of a remote radiographic reading system of the present invention;

Figure 3 is the remote radiographic reading system of Figure 2 shown being employed by a doctor;

Figure 4 is a laser projecting an image onto the retina of an eye of a user in accordance with a preferred embodiment of the present invention;

Figure 5 is an example of a set of images viewable using a radiographic reading system in accordance with a preferred embodiment of the present invention;

Figure 6 is a block diagram of a radiographic reading system in accordance with a preferred embodiment of the present invention; and

Figure 7 is a flowchart of a method of remotely reading radiographic images in accordance with a preferred embodiment of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

The present invention overcomes the aforementioned disadvantages as well as others. The present invention provides a system and method for remotely reading radiological images, including 3-D images. With reference to Figures 1–3, a preferred embodiment of the present invention includes using a direct retinal impingement head-mounted display unit **10** to view images. The head-mounted display unit **10** uses a laser **12** to project an

BNSDOCID: <WO_____0233681A2_I_>

image upon the retinas **14** of the eyes **16** of the radiologist **18**. The head-mounted display unit **10** also reduces ambient light and visual distractions, eliminating the need for the controlled environment of a radiological reading room. Thus, the invention provides for a controlled reading environment that is portable.

With reference to Figure 6, radiological images are acquired using an acquisition device **20** such as a Magnetic Resonance Imaging scanner or a Computed Tomography scanner. The radiographic images, including DICOM compliant images, are retrieved from a server and storage device **22**, such as employed in a PACS system **24**, using a remote computer **26** coupled to the head-mounted display unit **10**. The retrieval can be accomplished for example by logging directly into a hospital network **28** such as a Hospital Information System (HIS) or Radiology Information System (RIS), as shown in Figure 1. Or the retrieval can be accomplished by receiving, though a transceiver **30**, a broadcast signal such as commonly used in cellular communication technology **32**, as shown in Figure 2. However, those skilled in the art will recognize that other any of a variety of other means of image retrieval are within the scope of the present invention. In one preferred embodiment, the remote computer **26** is a conventional notebook computer modified to support the head-mounted display unit **10**, as shown in figure 1. In another preferred embodiment, the computer **26** is a belt-hung computer, as shown in Figures 2 and 3.

With reference to Figure 7, in a preferred method, a radiographic image or set of images is first acquired, as in step **36**, and stored, as in step **38**. The radiologist then retrieves at least one image, either from a remote server **24** and storage **22** or from a local storage unit **34**, for example a CD-ROM, coupled to the head-mounted display computer **26**, as in step **40**. In one mode of operation, the radiologist **18** retrieves a set of related images, and views them on the display, as in step **42**. The radiologist then selects a configuration with which to view the images, including which images to display simultaneously and the relative size and position of each image, as in step **44**. The radiologist then manipulates the images as required for viewing, as in

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step **46**. For instance, the radiologist may adjust contrast settings, select a level of zoom, or apply other desired manipulations such as image processing algorithms. Once the images have been satisfactorily manipulated, the radiologist analyzes the images, as in step **48**, and records the findings and diagnosis, as in step **50**. This can include adding annotation directly to the image files, as in step **52**. The findings can then be appended to the patient record for record keeping and diagnosis, as in step **54**.

The configurations are chosen, the images are manipulated, and the annotation is added using an interface device **56** such as a one-hand joystick (shown in Figure 1). One skilled in the art will recognize that any of a number of interface devices can be employed, for example a virtual reality glove (shown in Figures 2 and 3), a keyboard, or voice commands, and hence are within the scope of the present invention. The interface device **56** interacts with the images and a graphical user interface **58**, shown on Figure 5, which can include buttons and menus.

In another preferred embodiment of the present invention, the radiological reading method includes viewing at least one image while performing surgery. For example, a doctor could use the present invention to produce an x-ray overlay of the patient to aid in the surgery.

The above described methods and apparatus have the important advantage that they allow a radiologist to view radiological images in a remote location while maintaining a controlled viewing environment. The radiologist can then teleconference with doctors and hospital staff who can provide the direct patient care in response to the remote diagnosis. Furthermore, the use of a direct retinal impingement head-mounted display unit also provides the additional advantages of an extremely bright image and a reduction in eye strain, among other advantages.

Those skilled in the art can now appreciate from the foregoing description that the broad teachings of the present invention can be implemented in a variety of forms. Therefore, while this invention has been described in connection with particular examples thereof, the true scope of the invention should not be so limited since other modifications will become

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apparent to the skilled practitioner upon a study of the drawings, specification and following claims.

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CLAIMS

What is claimed:

1. A method of remotely viewing radiographic images, the method comprising:

acquiring at least one radiographic image;

retrieving the at least one radiographic image from a remote network; and

viewing the at least one image using a portable viewing unit.

2. The method of Claim 1, wherein the portable viewing unit is head-mounted viewing unit.

3. The method of Claim 2, further comprising the step of:

using the head-mounted viewing unit to project the at least one image on the retinas of the eyes of a viewer, wherein the head-mounted viewing unit uses a laser to project the at least one image.

4. The method of Claim 1, further comprising the step of manipulating the at least one image using an interface device.

5. The method of Claim 1, wherein the step of retrieving the at least one image further comprises downloading the at least one image from the Internet.

6. The method of Claim 1, wherein the step of retrieving the at least one image further comprises the step of using wireless technology to transmit the at least one image.

7. An apparatus for remotely viewing a radiographic image, the apparatus comprising:

an image acquisition system;

a portable computing device;

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a portable viewing unit coupled to the portable computing device, wherein the portable computing device retrieves the image from the image acquisition system and displays the image using the portable viewing unit.

8. The apparatus of Claim 7, wherein the image acquisition system includes a hospital network.

9. The apparatus of Claim 7, wherein the portable computing device is a laptop computer.

10. The apparatus of Claim 7, wherein the portable computing device is a belt mounted computer.

11. The apparatus of Claim 7, wherein the portable viewing unit is a head-mounted unit.

12. The apparatus of Claim 11, wherein the portable viewing device includes at least one laser for projecting the image on the retinas of the eyes of a user.

13. A method of diagnosing a patient, the method comprising:
acquiring a radiographic image;
remotely retrieving the image;
analyzing the image on a remote viewing device; and
making a diagnosis based on the image viewed on the viewing device.

14. The apparatus of claim 7, wherein the image acquisition system includes a joystick human interface control designed for rapid selection and manipulation of the images viewed.

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15. The apparatus of claim 14, wherein the functions of controls can be programmed by the user to facilitate image selection and manipulation for different modalities and user preferences.

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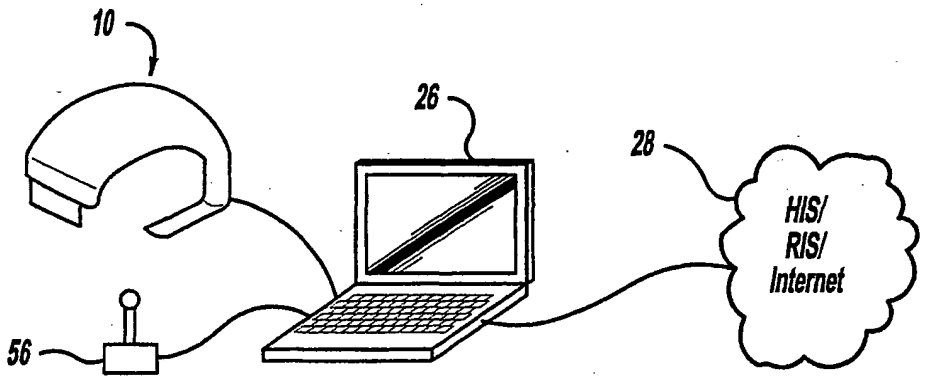


Figure - 1

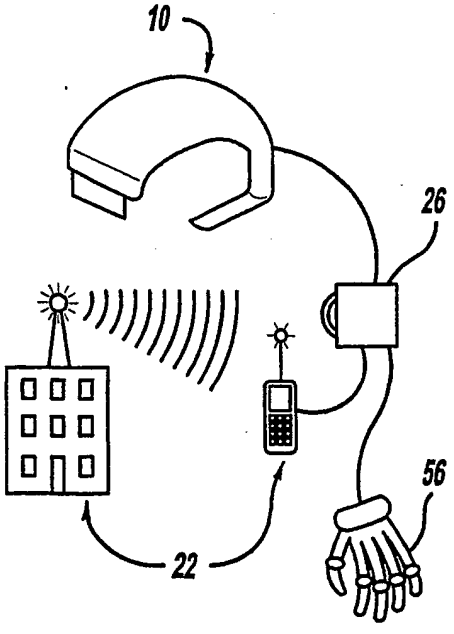
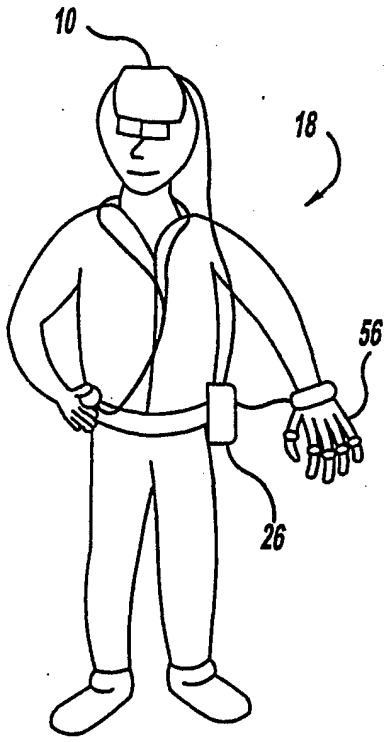


Figure - 2



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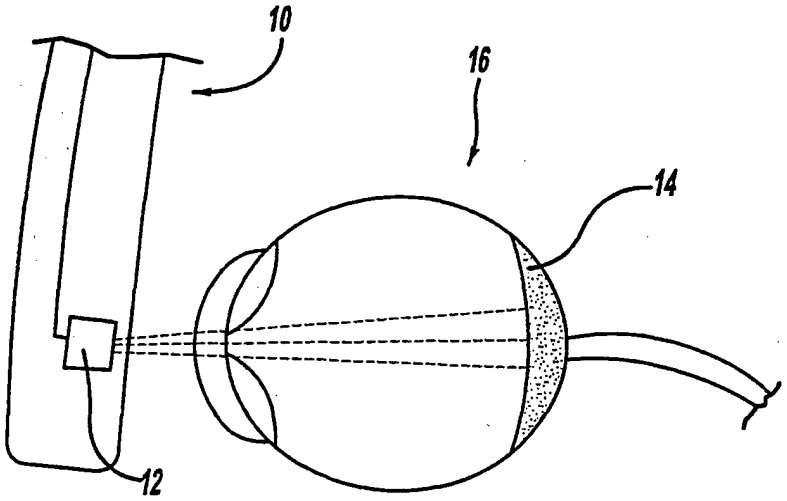

Figure - 4

BNSDOCID: <WO_____0233681A2_I_>

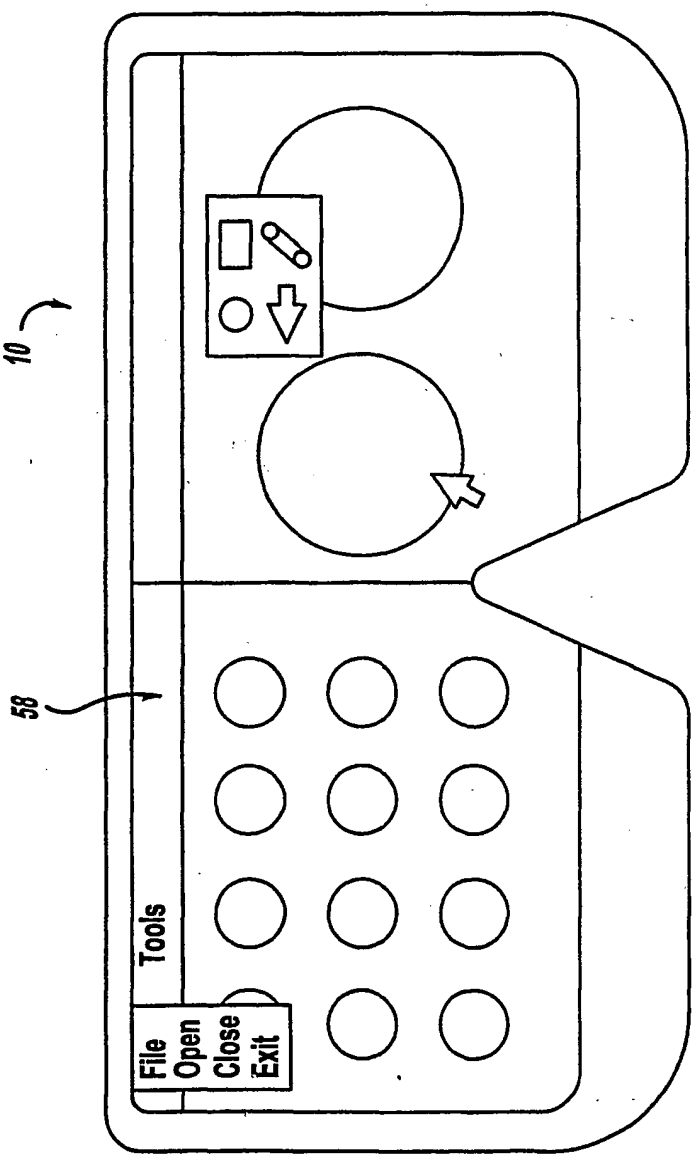

Figure - 5

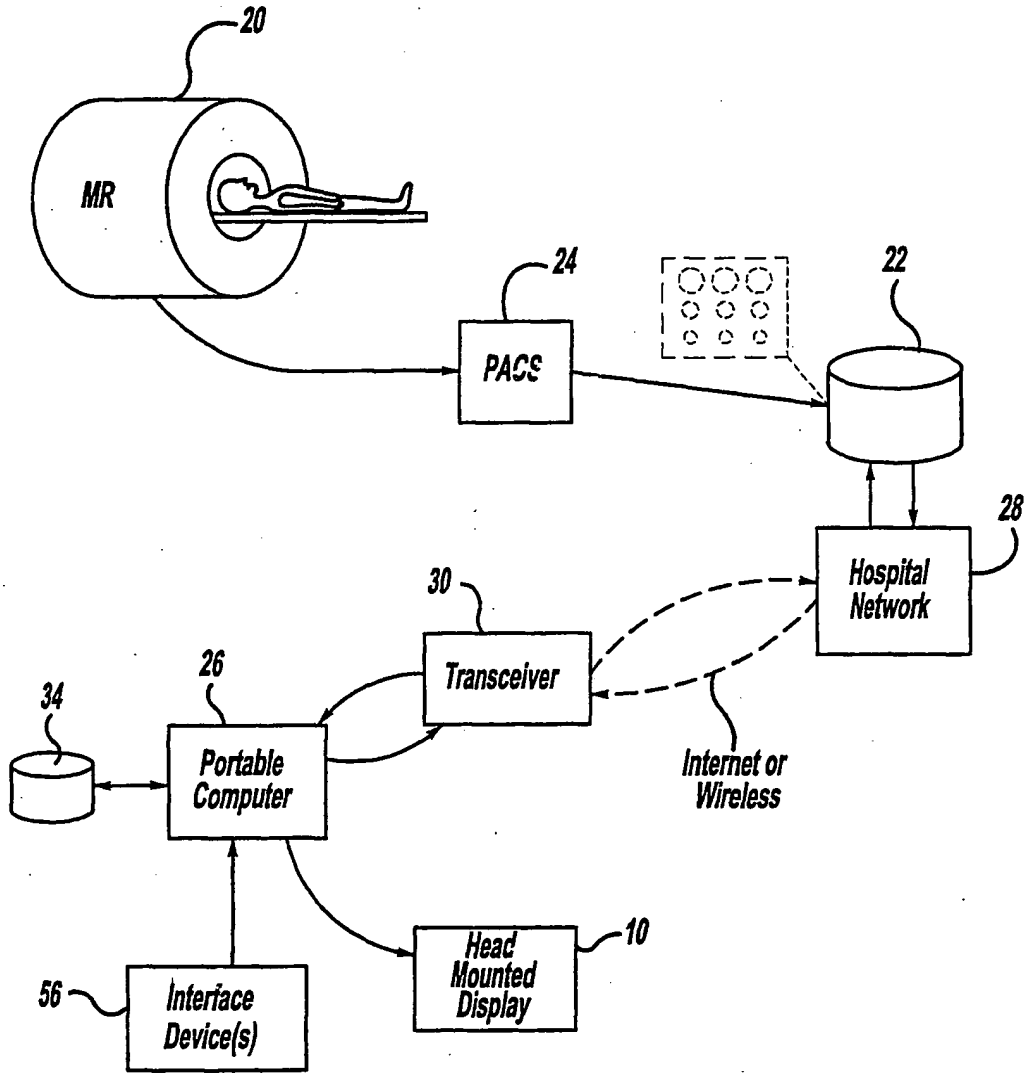
20
MR
24
PACS
22
28
Hospital Network
30
Transceiver
26
34
Portable Computer
Internet or Wireless
10
Head Mounted Display
56
Interface Device(s)

Figure - 6

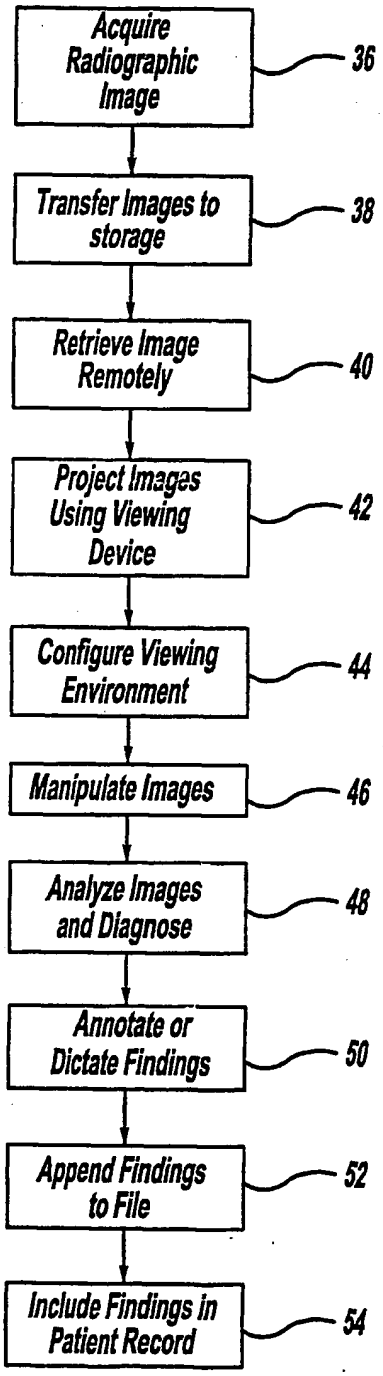
Acquire Radiographic Image
36
Transfer Images to storage
38
Retrieve Image Remotely
40
Project Images Using Viewing Device
42
Configure Viewing Environment
44
Manipulate Images
46
Analyze Images and Diagnose
48
Annotate or Dictate Findings
50
Append Findings to File
52
Include Findings in Patient Record
54

Figure - 7

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
25 April 2002 (25.04.2002)

PCT

(10) International Publication Number
WO 02/033681 A3

(51) International Patent Classification[7]: A61B 6/00

(21) International Application Number: PCT/US01/32252

(22) International Filing Date: 17 October 2001 (17.10.2001)

(25) Filing Language: English

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(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*
— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

(88) Date of publication of the international search report:
1 August 2002

[Continued on next page]

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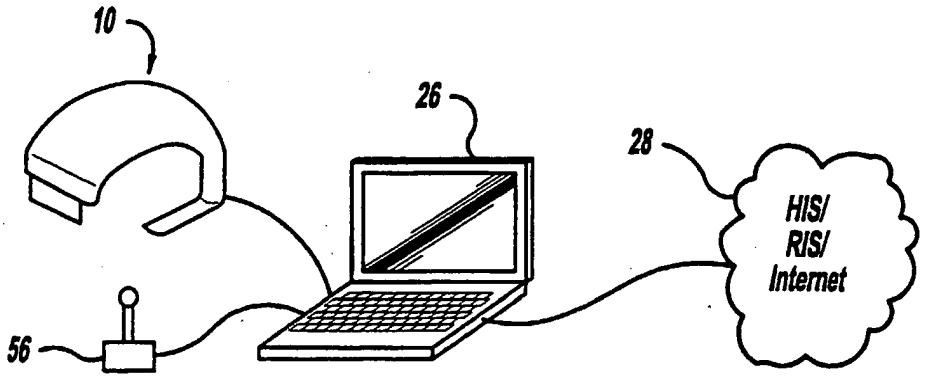

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WO 02/033681 A3

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 01/32252

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 A61B6/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 A61B G02B H04N G06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 546 943 A (GOULD) 20 August 1996 (1996-08-20) column 1, line 15 -column 2, line 5 column 3, line 28 -column 7, line 67 figures 1-3	7
A		8,9,11, 12

X	US 6 057 966 A (CARROLL ET AL.) 2 May 2000 (2000-05-02) abstract column 3, line 49 -column 5, line 17 column 6, line 7 -column 7, line 30 column 8, line 21 -column 9, line 59 column 13, line 62 -column 16, line 5 column 17, line 41 - line 62 figures 1-4,25-32	7
A		8-11

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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Date of the actual completion of the international search	Date of mailing of the international search report
17 May 2002	29/05/2002

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Chen, A

Form PCT/ISA/210 (second sheet) (July 1992)

BNSDOCID: <WO 02336B1A3 | >

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 01/32252

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 2 167 266 A (SCHOOLMAN) 21 May 1986 (1986-05-21) page 1, line 126 -page 3, line 87 figures 3-5	7
A		11

X	US 5 281 957 A (SCHOOLMAN) 25 January 1994 (1994-01-25) column 4, line 61 -column 5, line 46 column 6, line 50 -column 8, line 25 figures 1-5,10	7
A		8,11

A	US 5 727 098 A (JACOBSON) 10 March 1998 (1998-03-10) column 6, line 64 -column 7, line 14 column 11, line 6 - line 32 figures 1,7	7,12

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